

CLAIMS

What is claimed is:

- 1 1. A method of fabricating a photovoltaic device, comprising:
 - 2 providing a substrate;
 - 3 forming an electrode first film on the substrate;
 - 4 forming a semiconductor second film on the electrode first film;
 - 5 forming a semiconductor third film on the semiconductor second film; and
 - 6 forming an electrode fourth film on the semiconductor third, film
 - 7 wherein one of forming the second film and forming the third film includes:
 - 8 depositing semiconductor material using a deposition source; and
 - 9 supplying focussed energy to the semiconductor material to deposit the
 - 10 semiconductor material into a highly ordered crystalline film structure.
- 1 2. The method of claim 1, wherein supplying energy includes supplying energized
 - 2 particles having energy of greater than about 5eV and less than about 3000eV.
- 1 ³ 3. The method of claim 1, wherein supplying energy includes supplying energized
 - 2 particles having energy in the range of about 5eV to about 500 eV.
- 1 ⁴ 4. The method of claim 1, wherein supplying energy includes supplying energized
 - 2 particles having energy in the range of about 5eV to about 250 eV.
- 1 ⁵ 5. The method of claim 1, wherein supplying energy includes supplying energized
 - 2 particles having energy in the range of about 10eV to about 200 eV.
- 1 ⁶ 6. The method of claim 1, wherein supplying energy includes supplying energized
 - 2 particles having energy in the range of about 20 eV to about 40 eV.

1 ¹⁷ 8. The method of claim 1, wherein forming the second film includes depositing
2 CdS.

1 ¹⁸ 9. The method of claim 1, wherein forming the third film includes depositing CdTe.

1 ¹⁹ 10. The method of claim 1, wherein forming the second film includes the supplying
2 energy, and wherein the supplying energy includes supplying ionized sulfur.

1 ¹¹⁰ 11. The method of claim 10, wherein forming the second film includes depositing
2 the cadmium and reacting the cadmium with the ionized sulfur.

1 ¹¹¹ 12. The method of claim 1, wherein forming the third film includes the supplying
2 energy, and wherein the supplying energy includes supplying energized ions.

1 ¹¹² 13. The method of claim 1, wherein supplying energy includes supplying ions
2 simultaneously with depositing material from the deposition source.

1 ¹¹³ 14. The method of claim 1, wherein supplying energy includes supplying oxygen
2 ions.

1 ¹¹⁴ 15. The method of claim 1, wherein the substrate is not heated during forming the
2 second film or the third film.

1 ¹¹⁵ 16. The method of claim 1, wherein forming the semiconductor third film on the
2 semiconductor second film includes depositing a high quality first region and then
3 depositing a second highly doped region on the first region.

1 ¹¹⁶ 17. The method of claim 1, wherein the one of forming the second film and forming
2 the third film includes providing energy to the semiconductor material being
3 deposited by only means sending the semiconductor material toward the cell and by
4 the means supplying energy.

1 ¹⁸ A photovoltaic cell made according to a method comprising:
2 providing a substrate;
3 forming a essentially transparent electrode first film on the substrate;
4 forming a semiconductor second film on the electrode first film;
5 forming a semiconductor third film on the semiconductor second film; and
6 forming an electrode fourth film on the semiconductor third, film
7 wherein one of forming the second film and forming the third film includes:
8 depositing semiconductor material using a deposition source; and
9 supplying focussed energy to the semiconductor material to deposit the
10 semiconductor material into a highly ordered crystalline film structure.

1 ¹⁸ A photovoltaic cell made according to claim ¹⁷18, further wherein
2 the substrate is essentially transparent; and
3 the semiconductor third film includes a high quality first region adjacent to
4 the second film and a highly doped second region remote from the second film, and
5 the first region and the second film form a PN junction of the photovoltaic cell.

1 ¹⁹ An apparatus for fabricating a photovoltaic device on a substrate, comprising:
2 means for forming an electrode first film on the substrate;
3 means for forming a high-quality semiconductor second film on the
4 electrode first film;
5 means for forming a high-quality semiconductor third film on the
6 semiconductor second film; and
7 means for forming an electrode fourth film on the semiconductor third, film
8 wherein one of the means for forming the second film and the means for
9 forming the third film includes:
10 means for depositing semiconductor material using a deposition source and for
11 supplying focused energy to the semiconductor material to deposit the
12 semiconductor material into a highly ordered crystalline film structure.